1.1 Data Health Thread Overview

Data Health is based upon a number of parameters, some of which may be external to the system. Data Health is the term applied to the integrity of a Function Designator (FD) value which is being distributed from a CLCS subsystem. It consists of a group of flags which are associated with every FD. Each of the flags is "owned" by different processes within the CLCS system. For example, certain flags that deal with the decommutation of the data from its source are "owned" by processes in the CLCS Gateway. Other flags are owned by processes which correlate various data to determine additional "health" information about one or more Function Designators. This information is available to all CLCS processes which utilize FD data.

The Data Health Thread establishes the CLCS capability to provide health information for FD's. This thread will support initial Data Path Health editing, building, loading, processing, and viewing. This thread will support initial Data Health loading, processing, viewing, logging and retrieving.

1.2 Data Health Thread Concept

The Data Health thread can be divided into two segments, a user development segment, and a run time segment.
   The user development segment involves:
- Offline definition of Data Health algorithms, via the use of a Data Path Editor.
- Integrate Test build of the Data Health Algorithm Tables

   The run time segment consists of the following:
- Loading the Data Path Health Algorithm Tables at the DDP
- Applying data health on FDs received at the DDP, based on Data Health bit and Data Path Health bit information.
- Users viewing of data path information on the System Viewer at the HCI.
- Data with health information being recorded and made available for retrieval.

Data Health Thread - Concept Diagram

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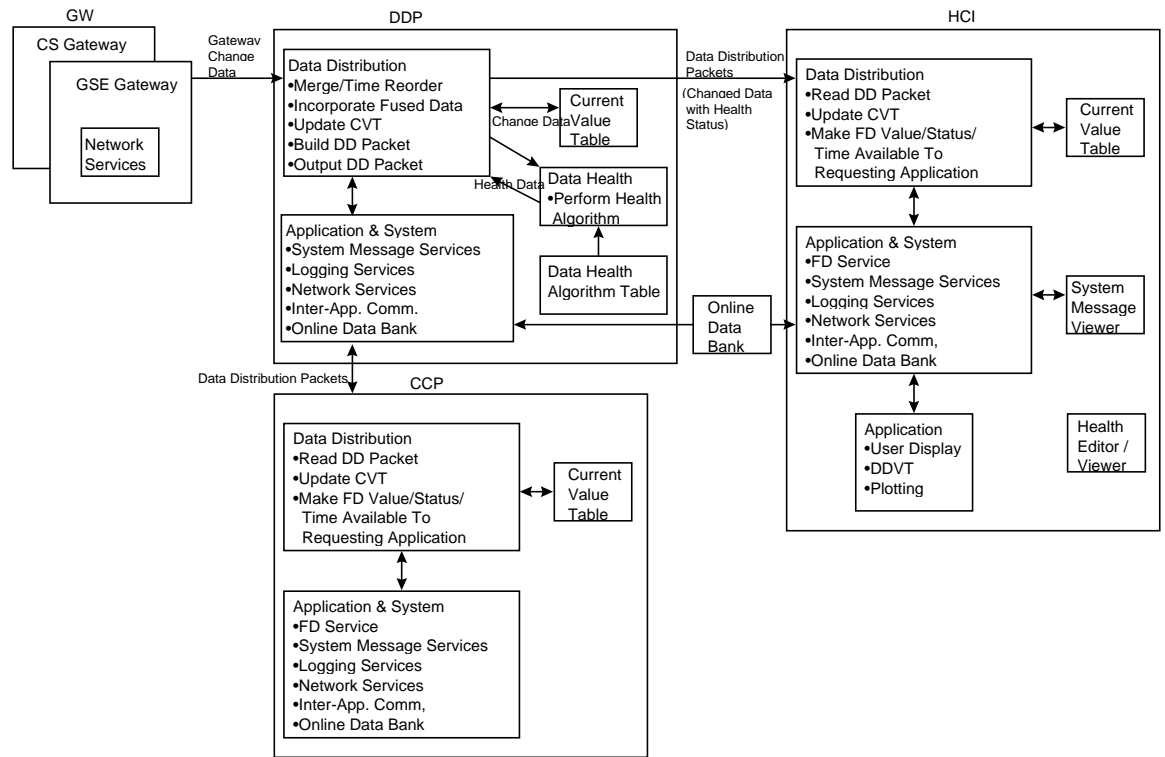
1.2.1 Data Health Bits Representation

The concept of Data Health of a Functional Designator is that it can be represented by a set of bits, or a single bit with a set of associated reason codes.   Regardless of the target form of representation, there are two major categories of health status:

System error - which indicates that the status is determined by the system and the quality of the status is guaranteed. Some examples of system error are listed below:

- **FD Processing Active (F1)** - Set by the Gateway when an FD level failure is detected. Examples of the failure condition include:
  - Data Acquisition inhibited
  - Data Processing Inhibited
- **Gateway Group Processing Active (F2)** - Set by the Gateway, System Integrity or Redundancy Management when FD group level failure is detected. Some examples of failure condition are listed below:
  - No data is received from HIM
  - Redundancy Management detects Gateway is down
  - Unable to regain PCM Frame Synchronization
  - Not in current format

Non-system error, indicating that the status is not quality guaranteed, and that further investigative action or operator/engineer intervention/decision is needed.   Examples of non-system errors are listed below:

- **Engineering Active (F3)** - Set manually by an engineer. Usually there is paperwork that calls for the specific bit to be set. An example is a problem report indicating that certain LRU is broken, or removed.
- **Data Path Active (W1)** - This bit is owned by Data Path Health (will be referred as the DP bit from here on). Conditions and mechanisms that cause this bit to be set will be discussed in the next section.
- **Application Advisory Active (W2)** - This is an Application Advisory Warning bit to be set by User Advisory Application via AI advisory tools (e.g. GENSYM/G2)

1.2.2 Data Path Health Bit Setting Mechanism

The Data Path Health bit is set by Data Path Processing via the execution of User Application Data Path logic. Data Path Processing supports 3 types of health computations to define Data Path Health value used to set this particular bit. The bit is set to the inhibited state if any of the following health checks result in the inhibited state.

- Wiring Health - Periodically, the state of each functional path is obtained from an external file (e.g. SCAN discrepancy file) and the DP bit of the FD associated with each of the functional paths is set/reset. Currently 3 states are defined for each functional path: mated, demated and validated. The Functional Path and FD association is mapped in a separate file.

   An example entry of the SCAN Discrepancy File is listed below:

Functional Path Name	State
"Fuel Cell #1 Power"	Validated/mated/demated

   An example entry of the FP/FD association file is listed below:

FD Name	Functional Path Name
V76X1234P1	"Fuel Cell #1 Power"

- Transition Tracking Health - This is a dynamic interface which is continuously waiting on inputs from End Item Managers.   Whenever there is a discrepancy between the actual data and the expected data, Constraint Manager will send an event notification to the target End Item Manager. Upon receipt of the notification, the End Item Manager will determine if the DP bit of any FDs owned by the End Item Manager needs to be set, and issue the request via Application Services.

- Dependency Tracking Health - The Data Health Logic Application monitors the state of a predefined list of FDs against their respective required state.   When one or more of these FDs fails to be in the required state, Data Path Health of the associated FD is inhibited.
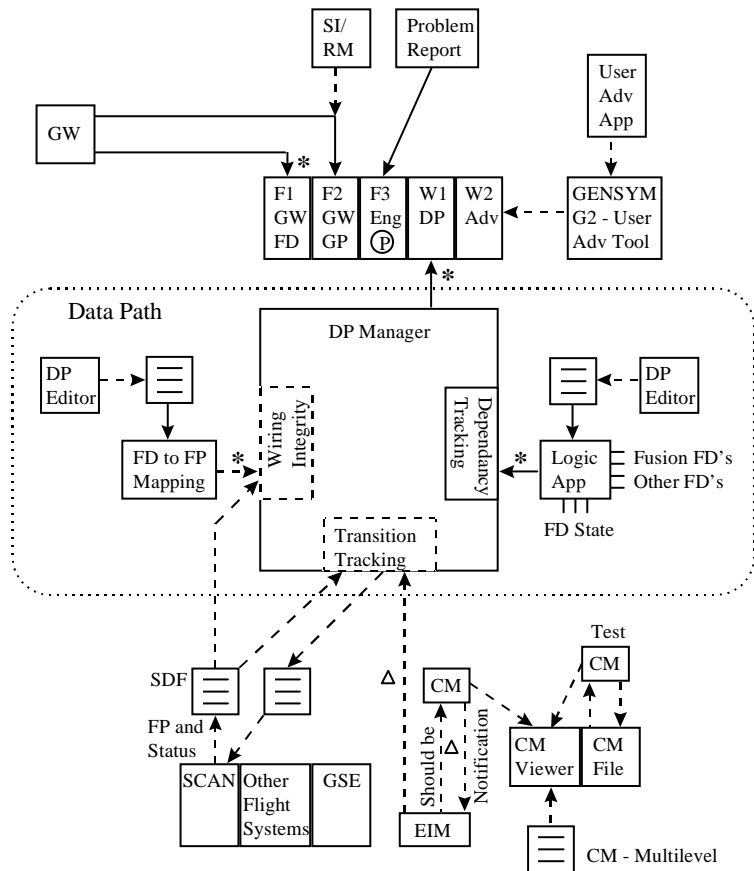
   An example entry of the FD State File is listed below:

FD Name	FD Name List	Required States/Limits	Units
A	V7CK1234P1, …, …	[#Low]:[#High], …, …	PSIA
B	V7CE1234E1	on	on/off

- The list of FDs and the target state, will all be pre-defined in a manually generated file for Redstone. This file will be generated by the Data Path Editor for later deliveries.

Data Path Health Concept

Symbols and Abbreviations

*	Redstone Delivery Item
- - -	Non-Redstone Delivery Item
Δ	Change Data
Ⓟ	Persistent Bit Status "ON"
SI	System Integrity
RM	Redundancy Management
DP	Data Path
Fn	Failure (F1, F2, F3)
Wn	Warning (W1, W2)
CM	Constraint Management
EIM	End Item Manager
FP	Functional Path
FD	Functional Designator
SDF	SCAN Discrepency File

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1.3 Data Health Thread Specification

	Statement of Work	Actions to be taken
1	Develop the Concept of Operations of how Data Health will be utilized by the User. • Define the list of Data Health requirements for both system processes and use processes. • Define the relationships between Data Health and other system processes such as Data Fusion.	Study Report. Need to be done by end of June and be shown on Redstone schedule.
2	Define and then provide the Initial Pre-build Data Path Health Editor. The viewer will, for all health bits, display any reason information including data path algorithms with input for multiple FD's.	Study. Perform trade study and select tools by 6/30/97.
3	Define and then provide the Initial System Viewer capability for FD Health. The viewer will, for all health bits, display any reason information including data path algorithms with input and internal values. The viewer will allow updates at a TBD request rate.	For viewer, only show status, but not algorithms for Redstone.
4	Define the Databank impacts for Data Health and provide the capability to add Data Health and Data Path Health information to the Databank.	Part of study, since there is no Data Bank impact until concept is defined.
5	Confirm and or modify system data flow for data health.	Provide modifications to Data Flow diagrams, if needed.
6	Confirm and modify System Services for data health.	Work with System Services and Application Services to define new requirements if needed by Data Health.
7	Confirm and modify the Data Health Bits. • Provide for Gateway Provided status. • Provide for DDP generation health bits. • Provide for advisory and engineering inputs from CCP and HCI.	Work with users to define health bits.
8	Coordinate design with Data Distribution and Data Fusion	Study. Incorporation of Gateway status bits will be Redstone implementation.
9	Determine if a COTS tool can be utilized and implement the selected approach.	Perform trade study and select tools. If a viable tool is selected, it will be made available for user testing on the Test Bed. Integration of COTS into OPS environment will be a Thor implementation.
10	Provide the capability to build Data Health Tables in the Test Build process.	Study.
11	Incorporate Data Health information into Data Distribution.	Redstone implementation.
12	Provide Initial record and retrieval capability	Redstone implementation.
13	Provide demonstration of at least one end to end GSE Analog health value.	Thor implementation.
14	Provide performance data for system modeling.	Initial data provided for Redstone.
15	Provide the capability for the Data Health function to be utilized in both Operational and Application configuration.	Initial implementation for Redstone.

1.4 Data Health Thread Assessment Summary

Number	CSCI/HWCI Name	CSCI Labor (Labor Month)	Redstone EP (Labor Months)	Base Cost Coverage
1	Data Distribution and Processing CSCI ■ Data Distribution CSC ■ Data Fusion CSC ■ Data Health CSC	48.0 mm	3.0 mm (make) 9.0 mm (COTS evaluation)	Data Distribution Thread Data Fusion Thread Data Health Thread (The 9 mm cost covers evaluation of a toll for both run time processing and the Data Path Editor)
2	System Services	0	0	Reliable Messages Phase 2 Thread
3	Application Services	0	0	Data Distribution Thread
4	System Viewers	0	0	User Display Monitor and Plotting thread
5	System Control	0	0	System Build and Load Thread
6	Consolidated System Gateway Services	0	0	System Build and Load Thread
8	CLCS Development Environment - CM tool and Development tool - Data Health Editor	0 24.0 mm	0 0	Covered by Facility Requirements Redstone evaluation is covered by the Data Health Thread.
9	TCID Build & Control	0	0	Test Build, Load & Activation Thread
10	Data Bank	0	0	Test Build, Load & Activation Thread
11	Data Recording & Archival	0	0	Data Distribution Thread
12	Data Retrieval	0	0	Data Distribution Thread
	Total	**72.0 mm**	**12.0 mm**	

** CSCI labor assessment will be provided/corrected in Requirement Panel.

1.5 Data Health Thread Hardware Diagram
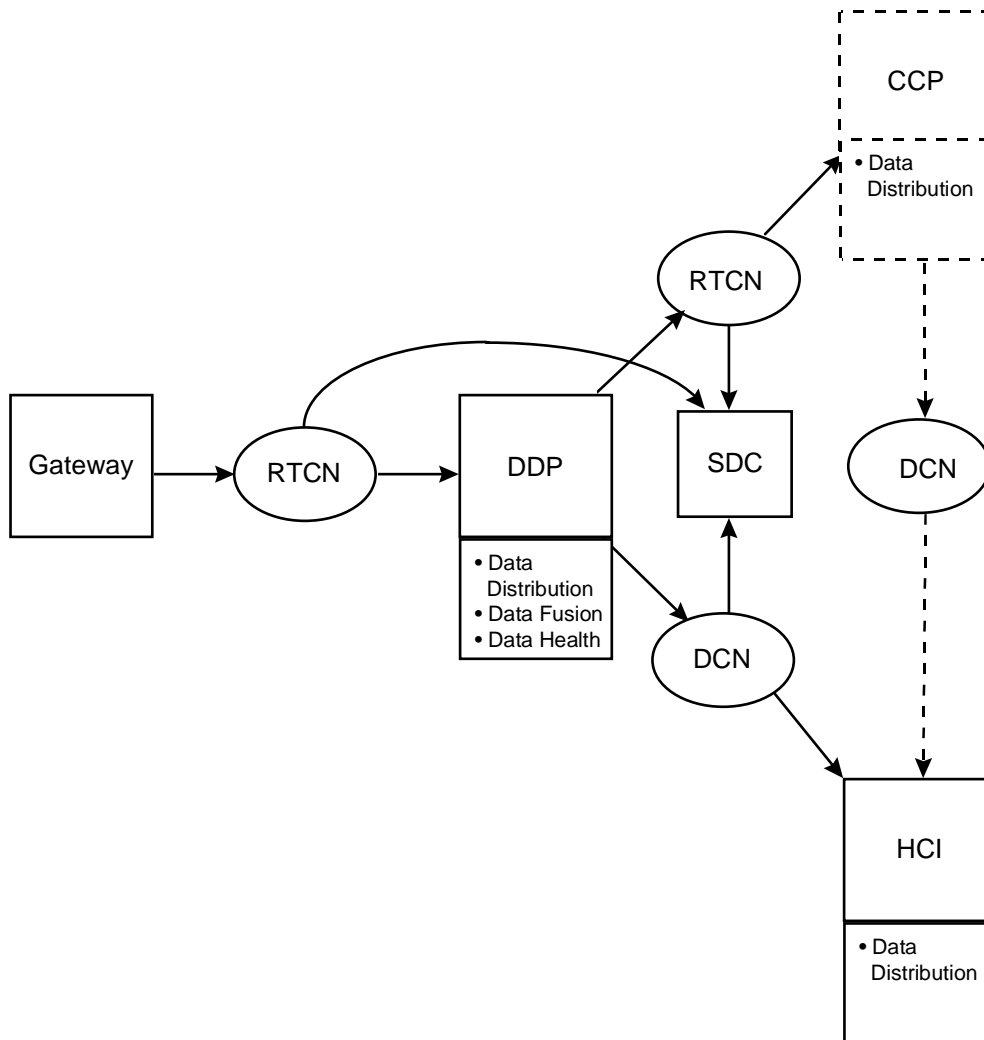
1.6 Data Health Thread Deliverables

The target Data Health tasks for Redstone consist of the following:
- Provide assessment and recommendation on long term Data Health operations
- Find the best of class tool for Data Health run time processing and for Data Path Editor. Common tools that can support multiple functions will be highly desirable. For example, a tool that can be used both as the Data Fusion Editor and the Data Path Editor.
- Incorporate health bits into Data Distribution.

The following deliverable products will be provided for the Redstone Delivery:
- Source code and executable software that support:
  - Incorporation of gateway supplied health bits into Data Distribution.
  - API to support application requests to set/reset specific health bit(s).
- Data Path Editor specifications.
- Data Health run time specifications.
- COTS evaluation report to provide recommendation based on weighed criteria.

If an acceptable tool is found, the following will be delivered into the Application Test Bed environment:
- The COTS tool.
- Documentation provided by the vendors.
- Provide the capability to monitor the state of a predefined list of FDs against their predefined required states. When one or more fail to match, set the Data Path bit.
  - The list of FDs and the target state, will all be pre-defined in a manually generated file for Redstone. This file will be generated by the Data Path Editor for later deliveries.

The following will be implemented for post Redstone deliveries:
- Parse SCAN Discrepancy File and set the Functional Path associated FDs accordingly.
  - SCAN file will be parsed once per shift.
  - SCAN file will be manually loaded once per shift
  - The Functional Path/FD Mapping File will be generated by the Data Path Editor.
- Provide support to parse or analyze data generated by GSE and other Flight Systems, then set the Functional Path associated FDs accordingly
- Provide APIs to support the following interface:
  - Transition Tracking
- The list of FDs and the target state for Dependency tracking will be generated by the Data Path Editor.

1.7 Data Health Thread Schedule

ID	Task Name	Start	Finish
	Redstone Assessment Kickoff	2/26/97	2/28/97
	Concept Panel Internal Review	3/12/97	3/12/97
	Concept Panel	3/26/97	3/26/97
	Data Health Concept defined and approved	3/27/97	5/01/97
	Redstone Development		
	Define Development Requirements for Redstone	5/01/97	5/08/97
	Identify and Resolve Dependencies	3/17/97	5/15/97
	Dependencies Resolved and Signed	5/15/97	5/15/97
	Requirement Panel Internal Review	5/16/97	5/16/97
	Requirement Panel for Make items	5/23/97	5/23/97
	Assess Cost and Prepare BOEs	5/23/97	5/30/97
	Detailed Design Panel for Make items	6/06/97	6/06/97
	Impacted CSCIs Unit Integration Testing Complete	8/04/97	8/04/97
	Impacted CSCIs development Integration Test	8/04/97	8/18/97
	Impacted CSCs Formal Integration Test	8/19/97	8/25/97
	Support System Integration Test	8/26/97	9/30/97
	Redstone Development Complete	9/30/97	9/30/97
	COTS Evaluation		
	Define DP Editor & Run time Processing COTS Specification	5/01/97	5/23/97
	COTS Specification Review	5/23/97	5/23/97
	Identify Candidate COTS to be evaluated	5/26/97	5/26/97
	Evaluate Candidates	5/27/97	6/23/97
	Evaluation Report Available	6/30/97	6/30/97
	Detailed Design Panel for COTS Recommendation	6/30/97	6/30/97
	Test Bed Installation of COTS (if viable tool is found)	7/01/97	7/04/97
	Test licensed COTS Tool Available for User Application Testing	7/14/97	7/14//97

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1.8 Data Health Thread Simulation Requirements

The Simulation Requirements for the Data Health Thread are listed below:

- A test driver shall be provided to simulate CS Gateway inputs in the absence of the final GSE Gateway software for remote UIT purposes.
- A canned set of data with known Data health outcome will be used as input to the test driver for verification purposes during UIT.

1.9 Data Health Thread System Test Requirement

Data Health end-to-end development testing will be performed prior to start of System Test:

- Data Generator provided by the CS and GSE Gateway will be used to generate a predefined and representative set of FD with known status. Rotational patterns will be used for variations.
- LAN analyzer will be used on the Network to track data rates.
- FD viewers will be used to visually verify FD health received at the HCIs.
- SDC recorded data will be used to verify FD health sent and received across the Network.
- Messages written to DDP local log and System messages sent to the HCIs will be used for debug and verification purposes.

System test plan and test procedures will be prepared by the System Test Organization.

1.10 Data Health Thread Training Requirements

The following training will be provided to the user

- Demonstration on usage of the Data Path Health COTS Tool (if a viable one is found)

Vendor Training required by the Data Health developers:

- Target CM tool
- Target development tool
- Candidate COTS Data Health Tools

1.11 Data Health Facilities Requirements

- The Data Health Thread will be requiring the same facility setup as the Data Distribution Thread. Refer to the Data Distribution Thread package for a list of the requirements.

1.12 Data Health Thread Procurement

- Potential procurement of a COTs tool for Data Health processing.
- Potential procurement of a COTs Data Path Health Editor.
- Potential procurement of a COTS Data Health Viewer.

1.13 Data Health Thread Dependencies

ID	CSCI Name	Data Health Development Key Dependencies	Need Date	CSCI/ HWCI
1	N/A	Redstone Payload Packet IDD	4/30/97	N/A
2	N/A	SDE-H Redstone Environment @ Houston	4/30/97	N/A
3	Application Services	API Definition (Preliminary) ■ FD Services ■ Online Data Bank Access Services ■ Logging Services ■ System Message Services ■ Inter-Application Communication Services	4/30/97	CSCI
4	Application Services	API Definition of above list (Final)	5/30/97	CSCI
5	System Control	TCID Descriptive Qualifier API definition (Prelim)	4/30/97	CSCI
6	System Control	TCID Descriptive Qualifier API definition (Final)	5/30/97	CSCI
7	System Services	Network Services Library @ Houston	6/16/97	CSCI
8	Application Services	Following Services Library @ Houston ■ Online Data Bank Access Services ■ Logging Services ■ System Message Services ■ Inter-Application Communication Services	6/16/97	CSCI
10	CS GW Services	Capability to output CS data with repeatable pattern @ Houston	6/16/97	CSCI
11	CLCS Dev Envmnt	Initial Fusion Editor @ Houston	7/07/97	CSCI
12	Data Distribution	Capability to pass GW change data to Data Health	6/23/97	CSCI
13	TCID Build & Control	TCID available @ Houston	7/07/97	CSCI
14	RTPS Sys SW Build	System Build Capability	7/07/97	CSCI
15	Data Distribution	Capability to incorporate Health status	7/07/95	CSCI
16	System Control	Load & Init application Capability @ Houston	8/04/97	CSCI
17	System Control	Capability to load TCID products @ Houston	8/04/97	CSCI
18	System Viewers	FD Viewer & FD Monitor @ Houston	8/04/97	CSCI
19	Recording, Archive and Retrieval	Capability to record and retrieve packets and FDs at KSC	8/04/97	CSCI
20	(SE Performance Personnel)	Performance Evaluation - Develop models, give timing and resource estimates and collect actual measurements provided by Data Health CSC.	8/04/97	N/A

ID	CSCI Name	Data Health COTS Evaluation Key Dependencies	Need Date	CSCI/ HWCI
1	(Vendors)	Training	5/27/97	N/A
2	System Services	Test Bed Platform Load Capability for DH COTS	7/01/97	CSCI
3	System Services	Performance Evaluation of COTS tool	7/14/97	CSCI

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1.14 Data Health Thread Action Items/Resolution

The following Data Health concepts and user requirements need to be defined:
- Status bits definition and transmission from the Gateways need to be resolved.
- Payload Packet definition needs to be resolved.

2. CI Assessments

2.1 Data Distribution and Processing CSCI Assessment

The following Data Distribution and Processing CSCI functions will be provided in support of the Data Fusion Thread:

Data Distribution CSC Work Required

- Coordinate Data Health design with Data Distribution and Data Fusion.
- Incorporate Data Health information into Data Distribution.

Data Health CSC Work Required

- Confirm and or modify system data flow for data health.
- Confirm and modify the Data Health Bits.
  - Provide for Gateway Provided status.
  - Provide for DDP generated health bits.
  - Provide for advisory and engineering inputs from CCP and HCI.
- Coordinate design with Data Distribution and Data Fusion
- Incorporate Data Health information into Data Distribution.
- Provide the capability for the Data Health function to be utilized in both Operational and Application configuration.

Function Name	CSCI Labor (EP)	% of CSCI	Function EP
Incorporate Data Health with DD and DF	2 mm		1 mm
Data Health Function	46 mm		2 mm
TOTAL	48 mm		3 mm

CSCI Labor will be provided/corrected at the Requirement Panel.

Lines of Code

Will be provided at the Requirement Panel.

Documentation

The following documentation with referencing to Data Health will be provided:
- Data Health Design Specification
- Data Health User's Guide

Assumptions

Refer to Data Health Thread Action Items / Resolutions Section (1.14).

Open Issue

Refer to Data Health Thread Action Items / Resolution Section (1.14).

2.2 System Services CSCI Assessment

The System Services CSCI capabilities to be provided in support of the Data Health Thread is identical to the services to be provided for Data Distribution Thread, with exception to the following addition:
- Provide capability to load DH COTS to the Application Test Bed.
- Provide support to performance evaluation of the Data Health COTS Tool.

Refer to the Data Distribution Assessment package for a description.

2.3 Application Services and Tools CSCI Assessment

The Application Services CSCI capabilities to be provided in support of the Data Health Thread is identical to the services to be provided for Data Distribution Thread. Refer to the Data Distribution Assessment package for a description.

2.4 System Viewers CSCI Assessment

The following capabilities will be provided by the System Viewers CSCI in support of the Data Health Thread:

System Views Work Required

- Provide Data Health Viewer

CSCI Assessment

The cost assessment for this CSCI is being provided by the User Display Monitor and Plotting Thread.

Documentation

Refer to the User Display Monitor and Plotting Thread Assessment Package.

Assumptions

Refer to the User Display Monitor and Plotting Thread Assessment Package.

2.5 System Control CSCI Assessment

The following capabilities will be provided by the System Control CSCI in support of the Data Health Thread:

OPS Configuration Manager CSC Work Required

The following requirements will be implemented:

- Provide the capability to load and initialize Data Health executables.
- Provide an API to a table of TCID descriptive qualifiers (e.g. Test name, vehicle, etc.).
- Provide Data Path Health Algorithm Tables on the DDP.

CSCI Assessment

The cost assessment for this CSCI is being provided by the System Build and Load Phase 1 Thread.

Documentation

Refer to the System Build and Load Phase 1 Thread Assessment Package.

Assumptions

Refer to the System Build and Load Phase 1 Thread Assessment Package.

2.6 TCID Build & Control CSCI Assessment

The following capabilities will be provided by the TCID Build and Control CSCI in support of the Data Health Thread:

Table Build Work Required

- Provide the capability to build Data Health Tables in the Test Build process.
- Define Data Bank impacts for Data Health and provide the capability to add Data Health and Data path Health information to the Data Bank.

CSCI Assessment

Cost and assessment is provided by the Test Build, Load and Activation Phase 1 Thread.

Lines of Code

Refer to the Test Build, Load and Activation Phase 1 Thread Assessment packet

Documentation

Refer to the Test Build, Load and Activation Phase 1 Thread Assessment packet.

Assumptions

Refer to the Test Build, Load and Activation Phase 1 Thread Assessment packet.

Open Issues

 Refer to the Test Build, Load and Activation Phase 1 Thread Assessment packet.

2.7 Data Recording & Archival CSCI Assessment

The Data Recording & Archival CSCI capabilities to be provided in support of the Data Health Thread is identical to the services to be provided for Data Distribution Thread. Refer to the Data Distribution Assessment package for a description.

2.8 Data Retrieval CSCI Assessment

The Data Recording & Archival CSCI capabilities to be provided in support of the Data Health Thread is identical to the services to be provided for Data Distribution Thread. Refer to the Data Distribution Assessment package for a description.

2.9 Application Editors & Compilers CSCI Assessment

The following capabilities will be provided in support of the Data Health Thread:

Data Path Editor/Compiler CSC Work Required

- Define and then provide the Initial Pre-build Data Path Health Editor.
- Determine if a COTS tool can be utilized and implement the selected approach.

CSCI Assessment

The assessment of the above support is covered by the run time tool assessment cost cost supplied by the Data Health CSC.

3. COTS Products Dependencies

3.1 SW Products Dependency List

Pending result of COTS evaluation.

3.2 HW Products Dependency List

DDP, HCI and Network hardware dependencies are covered under the Data Distribution Facility Requirements. Refer to the Data Distribution Thread Assessment Package.